Protective Clothing Based on Permselective Membrane and Carbon Adsorption

Developer: Membrane Technology & Research, Inc.
Contract Number: DE-AC21-93MC30179
Crosscutting Area: N/A

Deactivation & Decommissioning
FOCUS AREA

Problem:

Decontamination workers at Department of Energy (DOE) sites face potential contamination from a variety of hazardous compounds, including asbestos; mercury and other heavy metals; toxic organic compounds, such as PCBs and chlorinated solvents; and radioactive metals and salts. For many activities, they must wear protective garments which are impermeable to particulates, aerosols, and organic vapors and which provide protection from toxic contaminants. Current garments are heavy, time consuming to put on and remove, and impermeable to water vapor. Because body heat cannot escape, the potential for workers to become heat stressed is high, and frequent, lengthy rest periods are needed. Use of existing protective garments greatly reduces worker and process efficiency.

Solution:

Development and demonstration of improved protective clothing that provides personnel protection equivalent to current garments, but is water-vapor permeable to minimize heat stress, and lighter weight for improved wearer comfort. The improved protective clothing will be made of an innovative fabric that combines an ultrathin, permselective outer membrane with a sorptive inner layer. The outer membrane layer is extremely permeable to water, but highly impermeable to hazardous compounds; the sorptive inner layer captures any hazardous compounds that may breach the membrane layer.

Benefits:

▸Increased worker productivity due to greater comfort and reduced rest time

▸Reduced potential for heat stress due to the very-high water vapor transmission rate of the new fabric (up to 1,000 g/m^2-day or more)

▸Improved worker acceptance of protective clothing due to increased comfort

▸Equivalent, or better, protection of personnel by the new fabric

Technology:

The outer fabric that contacts the contaminated atmosphere is a nonporous, but permselective, polymer membrane. It permits the permeation of water vapor, but is

essentially impermeable to toxic organic compounds. Since the membrane is nonporous, it also acts as a complete barrier to penetration by particulates, aerosols, and liquids. Because penetration of the hazardous compound is greatly reduced by the permselective membrane, the sorptive layer can be relatively thin. The sorptive layer consists of carbon adsorbent dispersed in a microporous support membrane. The membrane layers are supported on a woven fabric that provides mechanical strength. A protective layer covering the outer surface of the permselective layer makes the fabric water repellent, seals any defects, and protects the permselective layer from abrasion.

Contacts:

Membrane Technology and Research, Inc. (MTR) was founded in 1982 as a membrane research company, investigating marketable membrane technologies. MTR's programs have focused on gas separation and pervaporation and have ranged from fundamental development to full-scale demonstrations. A number of commercial membrane separation systems have been installed by MTR. For information on this project, the contractor contact is:

Principal Investigator:
Mr. J. G. Wijmans
Membrane Technology & Research, Inc.
1360 Willow Road
Menlo Park, CA 94025-1516
Phone: (650) 328-2228
Fax: (650) 328-6580
E-mail: wijmans@mtrinc.com

DOE's Federal Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

DOE Project Manager:
Dr. Harold D. Shoemaker
Federal Energy Technology Center
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
Phone: (304) 285-4715
Fax: (304) 285-4403
E-mail: hshoem@fetc.doe.gov

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Phase II Start

Commercial Agreement

Laboratory Evaluation

IUOE Evaluation

Contract End

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